



## A revision of the *Thyropygus allevatus* group. Part 2: the *T. bifurcus* subgroup (Diplopoda, Spirostreptida, Harpagophoridae)

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### Abstract

The *Thyropygus bifurcus* subgroup of the *T. allevatus* group is revised. Four new species are described from Thailand: *T. demangei* n. sp., *T. quadricuspis* n. sp., *T. richardhoffmani* n. sp., from Trang province and *T. casjeekeli* n. sp., from Krabi province. The other species of the *T. bifurcus* subgroup, viz., *T. bifurcus* (Demange, 1986), and *T. enghoffi* (Demange, 1989), are redescribed.

**Key words:** millipede, taxonomy, new species, Thailand

### Introduction

The genus *Thyropygus* Pocock, 1894 is distributed broadly in Southeast Asia (Jeekel, 2006; Enghoff, 2005). Currently the genus *Thyropygus*, including its synonym *Cornugonus* Demange, 1961 (Pimvichai *et al.*, 2009) comprises 43 named species and a number of named subspecies (Jeekel, 2006, Pimvichai *et al.*, 2009). Hoffman (1975) grouped the species of *Thyropygus* in four species groups, including the *T. allevatus* (Karsch, 1881) group.

Pimvichai *et al.* (2009) provided diagnoses of the genus *Thyropygus* and the *T. allevatus* group and revised one subgroup of the latter, viz., the *T. opinatus* subgroup. They also mentioned a second subgroup, viz., the *T. bifurcus* subgroup which is the subject of the present paper. Further subgroups of the *T. allevatus* group will be defined and treated in forthcoming papers.

### Materials and methods

Newly collected specimens were hand-collected and preserved partly in 70% ethanol, and some were placed in a freezer at -20 °C for subsequent molecular studies. Specimens were examined from the following collections:

CUMZ	Museum of Zoology, Chulalongkorn University, Bangkok, Thailand
MNHN	Muséum national d'Histoire Naturelle, Paris, France
NMNH	National Museum of Natural History, Bulgarian Academy of Sciences, Bulgaria
ZMUC	Natural History Museum of Denmark (Zoological Museum), University of Copenhagen, Denmark

Drawings were based on photographs and examination of specimens under a stereo microscope.

Pimvichai *et al.* (2009: 21, figs 1–3) defined a number of terms for gonopods of the *T. allevatus* group. Most of these are used in the following descriptions, viz., (terms not in Pimvichai *et al.* 2009 in **bold**)

- Anterior coxal fold (*ac*): The main part of gonopod in anterior view. Confusingly called *posterior* coxal fold by Demange (1961) and Hoffman (1975).
- Lateral process of anterior coxal fold (*alp*): The distolateral part of the anterior coxal fold.
- Mesal process of anterior coxal fold (*amp*): An additional projection on the anterior coxal fold, protruding from its mesal margin.
- Blepharochaete (pl. -ae) (*bp*): The normal form of apical setae, long, slender, stiffened, and usually pigmented, somewhat reminiscent of the mammalian eyelash (Hoffman, 1975).
- Longitudinal crest in gutter of palette (*cr*): A crest which runs along the middle in gutter near the tip of palette.
- Femoral spine (*fe*, ***fe 1***, ***fe 2***): A usually long, curved spine on the telopodite, originating slightly distal to the point where the telopodite emerges from the coxa.
- **Lamellar lobe (*ll*)**: A small, slightly folded lobe at the basis of the apical part of the telopodite.
- Palette (*pa*): The distalmost lobe of the apical part, carrying the row of blepharochaetae.
- Posterior coxal fold (*pc*): The main part of gonopod in posterior view, usually shorter than *ac* and forming shelf for accommodation of telopodite shaft.
- Lateral process of posterior coxal fold (*plp*): The lateral part of the posterior coxal fold, normally digitiform.
- Mesal process of posterior coxal fold (*pmp*): The mesal part of the posterior coxal fold, normally forming a shelf (*sh*) for accommodation of telopodite shaft.
- Paracoxite (*px*): The basal, lateral part of the posterior coxal fold.
- Shelf (*sh*): The distal surface of the posterior coxal fold.
- Small spine (*ss*): An additional small spine at the base of the apical part of telopodite in posterior view.
- Sternum (*st*): A small, usually triangular sclerite between the basal parts of the anterior coxal folds.
- Tibial spine (*ti*): A usually long spine on the telopodite, originating distal to the femoral spine, at the basis of the apical part of the telopodite, usually curved in the opposite direction of the femoral spine, the two together forming a circle.
- Apical part: The part of the telopodite distal to the tibial spine.

### The *Thyropygus bifurcus* subgroup

A subgroup of the *T. allevatus* group, characterized by

1. An additional projection on the anterior coxal fold
2. A doubled femoral spine (exception: *T. casjeekeli* **n. sp.**, and *quadricuspis* **n. sp.**, which have a single femoral spine)
3. No spatulate lobe on the telopodite
4. A longitudinal rounded crest near tip of palette

The *T. bifurcus* subgroup includes *T. bifurcus* (Demange, 1986), *T. enghoffi* (Demange, 1989), and 4 new species; *T. casjeekeli* **n. sp.**, *T. demangei* **n. sp.**, *T. quadricuspis* **n. sp.**, and *T. richardhoffmani* **n. sp.**

The species within this subgroup not only share the diagnostic characters listed above but also many other characters.

## General description of the *T. bifurcus* subgroup

The general gonopod structure, as well as the characters of body rings, antennae, mandibles, gnathochilarium, collum, epiproct, paraprocts, hypoproct and first pair of male legs, are similar to those described for the *T. opinatus* subgroup by Pimvichai *et al.*, (2009).

We give here a general description of males of the *bifurcus* subgroup, emphasizing the differences from the *opinatus* subgroup.

Head smooth, 5–6 supralabral setae, eyes moderate in size, ocelli in 7–8 horizontal rows: 13–14, 12–14, 10–12, 8–10, 7–8, 5–7, 4–5, 2–4, total: 61–74.

Sterna smooth, stigmal grooves distinct, long. Legs relatively long; tip of postfemora, tibiae and tarsi visible from above when legs are extended laterad; coxae of anterior and posterior pair markedly dissimilar, posterior coxae humped; coxae with 1–6 setae, prefemora with 1–4 setae, femora with 2–4 setae in a median row and 2 larger subapical setae; tarsi typically with 6 irregularly placed ventral setae and 1–2 large dorsal apical spurs. Postfemora and tibiae without setae.

Gonopods: Sternum (*st*) triangular. Anterior coxal fold (*ac*) basally slender, becoming broader towards tip, lateral margins diverging; distally with two processes: a lateral process (*alp*) and the mesal process (*amp*); the shape of these processes is species-specific. Posterior coxal (*pc*) fold much lower than anterior coxal fold, basally with moderately high lateral paracoxites (*px*) distally always with a smooth area over which the telopodite shaft can slide; mesal process of posterior coxal fold (*pmp*) usually slender, directed distolaterad. Telopodite with two femoral spines (rarely one) and a long, slender, curved tibial spine (*ti*). A small and slightly folded lateral lamella (*ll*) at the apical part of telopodite. Apical palette (*pa*) simple, forming a broad gutter, with a longitudinal crest in the concavity; apically with a row of 7–10 brownish blepharochaetae (*bp*).

## Key to species of the *T. bifurcus* subgroup

- 1 Telopodite with a single femoral spine ..... 2
- 1\* Telopodite with a double femoral spine ..... 3
- 2 Lateral process of anterior coxal fold (*alp*) without an apical crest; mesal process of anterior coxal fold (*amp*) shorter than and as broad as *alp*, directed distad; femoral spine (*fe*) very long and slender ..... *Thyropygus casjeekeli* **n. sp.**
- 2\* Lateral process of anterior coxal fold (*alp*), with a sharp crest on the posterior surface near the tip (Fig. 5C, arrow); mesal process of anterior coxal fold (*amp*) almost as long as *alp*, straight, directed distad; femoral spine (*fe*) very long, slender, with an additional lamella at base (Fig 5D, arrow) ..... *Thyropygus quadricuspis* **n. sp.**
- 3 Lateral process of anterior coxal fold (*alp*) broader, terminating in a very short external spine and a very long internal one; mesal process of anterior coxal fold (*amp*) as long as *alp*; first femoral spine (*fe* 1) very short, pointed; second femoral spine (*fe* 2) very long, as long as tibial spine (*ti*); an additional lamella at both side of base of *fe* 2 ..... *Thyropygus richardhoffmani* **n. sp.**
- 3\* Lateral process of anterior coxal fold (*alp*) slender, regularly curved, sickle-shaped ..... 4
- 4 Mesal margin of lateral process of anterior coxal fold (*alp*) simple, without a caudad spine or crest; mesal process of anterior coxal fold (*amp*) much shorter than lateral process (*alp*), curved, pointed ..... *Thyropygus enghoffi* (Demange, 1989)
- 4\* Mesal margin of lateral process of anterior coxal fold (*alp*) with a caudad small spine or crest ..... 5
- 5 Mesal margin of lateral process of anterior coxal fold (*alp*) with a small caudad crest; mesal process of anterior coxal fold (*amp*) slightly shorter than *alp*, slightly sigmoid, pointed ..... *Thyropygus bifurcus* (Demange, 1986)
- 5\* Mesal margin of lateral process of anterior coxal fold (*alp*) with a short curved caudad spine; mesal process of anterior coxal fold (*amp*) as long as *alp*, straight ..... *Thyropygus demangei* **n. sp.**

## Species descriptions

### *Thyropygus bifurcus* (Demange, 1986)

(Figs. 1A–E)

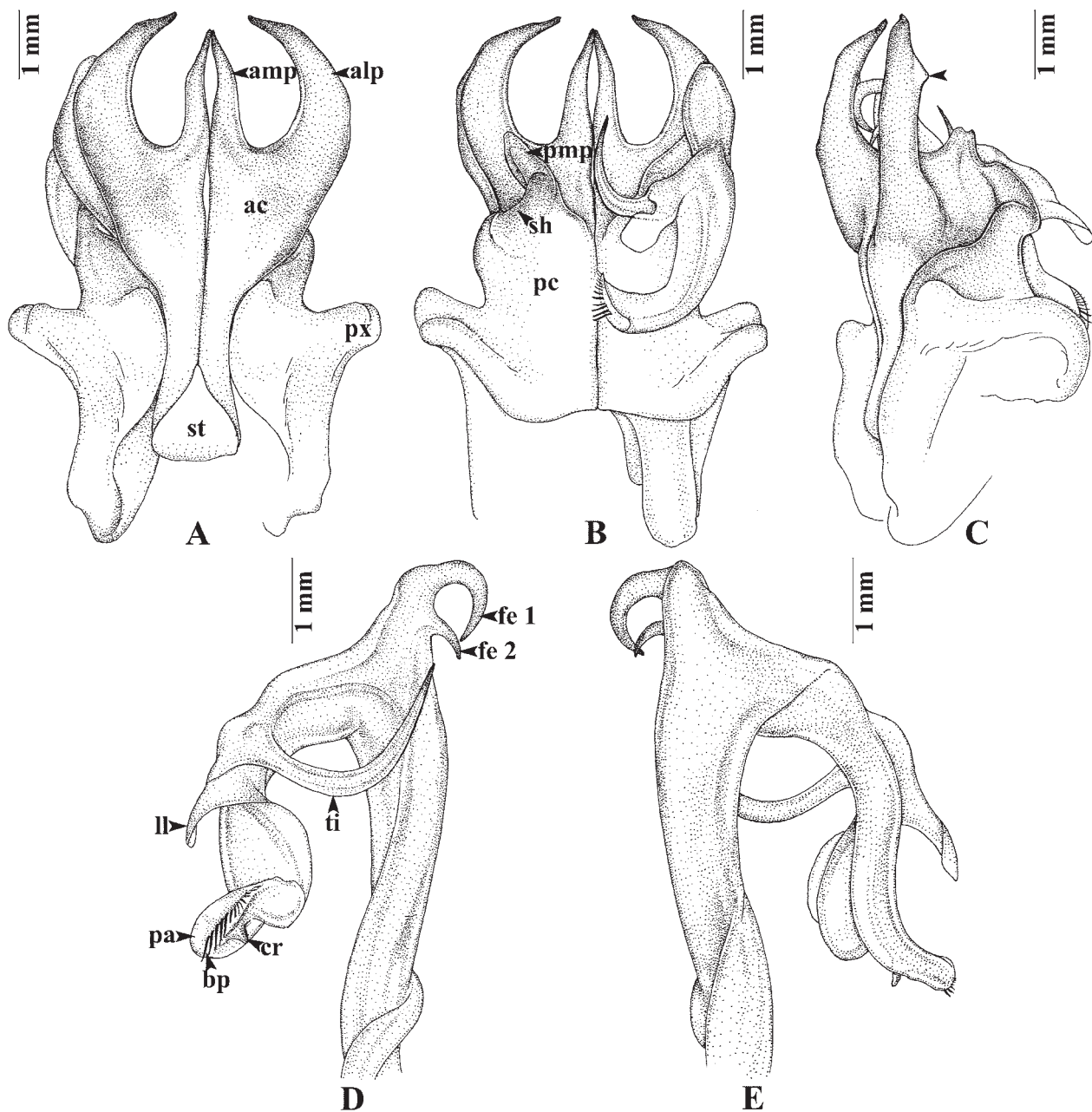
*Thyropisthus bifurcus* Demange, 1986: 852

[*Thyropisthus bifurcatus* Demange, 1986: 853, *lapsus calami*]

*Thyropygus bifurcus*: Enghoff 2005: 93

*Cornugonus bifurcus*: Jeekel 2006: 19

**Material:** HOLOTYPE male THAILAND, Nakhonsrithammarat Province, Khao Luang, 8° 34' 39" N, 99° 42' 55" E, B. Degerbøl leg., (ZMUC). – 1 male paratype, same data as holotype (ZMUC).



**FIGURE 1.** *Thyropygus bifurcus*, holotype, gonopods. A: anterior view, right telopodite removed. B: posterior view, right telopodite removed. C: lateral view. D: right telopodite, posterior-mesal view. E: right telopodite, anterior-lateral view.

**Diagnosis:** A species of the *bifurcus* subgroup. Lateral margin of lateral process of anterior coxal fold (*alp*) with a small crest. Similar in this respect to *T. demangei* and *T. quadricuspis*. Differs from *T. demangei* by having the first femoral spine (*fe 1*) almost as long as the second femoral spine (*fe 2*). Differs from *T. quadricuspis* by having a double femoral spine (*fe*). Differs from all other species of the *T. bifurcus* subgroup by having the lateral margin of *alp* folded caudad along the whole length.

**Description:** Adult males with 61–63 podous rings, no apodous rings. Length ca. 10 cm (broken), width ca. 8.0 mm. Color in life unknown; preserved holotype with head, antennae, legs, prozona, epiproct, paraprocts, and hypoproct brown; metazona and margins of paraprocts dark brown.

Gonopods (Figs. 1A–E): Anterior coxal fold (*ac*) (Fig. 1A): lateral process (*alp*) regularly curved, in anterior view sickle-shaped, lateral margins folded caudad along entire length, with a small crest (Fig. 1C, arrow), ca. 1/3 from tip; mesal process (*amp*) slightly shorter than lateral process, directed distad, slightly sigmoid, pointed. Posterior coxal fold (*pc*) (Fig. 1B) basally with moderately high lateral paracoxites (*px*), distally truncate, forming shelf (*sh*) for accommodation of telopodite; mesal process (*pmp*) slender, directed distolaterad. Telopodite (Figs. 1D–E) leaving coxite over shelf of posterior coxal fold; double femoral spine (*fe*), the first *fe* (*fe 1*) slender, inflexed, *in situ* resting against posterior surface of *alp*, the second *fe* (*fe 2*) situated under *fe 1*, slender, curved rearwards; tibial spine (*ti*) long, slender, curving in horizontal plane; apical part: lamellar lobe (*ll*) small, slightly twisted; palette (*pa*) simple, with a longitudinal rounded crest (*cr*) near tip, distally with about eight brownish blepharochaetae (*bp*).

**Distribution** (Fig. 8): Known only from the type locality.

### ***Thyropygus enghoffi* (Demange, 1989)**

(Figs. 2A–D, 7B)

*Thyropisthus enghoffi* Demange, 1989: 779

*Thyropygus enghoffi*: Enghoff 2005: 94

*Cornugonus enghoffi*: Jeekel 2006: 19

**Material:** HOLOTYPE male THAILAND, Phang Nga Province, Pong-chang cave, 8° 31' 40" N, 98° 29' 58" E. 19 August 1987. L. Deharveng leg., (MNHN), 2 males THAILAND, Phang Nga Province, Khao Lak. 28 August–13 September 2008. P. Decker leg., (ZMUC), 1 male THAILAND, Phang Nga Province, Tai Muang district, Khao Lak Lam-Ru National Park, 8° 37' 34" N, 98° 14' 23" E. 17 October 2008. P. Prasankok leg., (CUMZ), 1 male, 1 female THAILAND, Phang Nga Province, Mueang district, Nam Pud cave, 8° 27' 47" N, 98° 32' 30" E. 17 January 2009. P. Pimvichai and C. Sutcharit leg., (CUMZ), 1 male THAILAND, Phuket Province, Phuket Island, Thalang district, Tonesai waterfall, 8° 3' 47" N, 98° 21' 7" E. 17 November 1984. P. Beron & S. Andreev leg., (NMNH).

**Diagnosis:** A species of the *bifurcus* subgroup. Lateral margin of lateral process of anterior coxal fold (*alp*) without a small crest or spine. Similar in this respect to *T. casjeekeli* and *T. richardhoffmani*. Differs from all other species of *T. bifurcus* subgroup by having the mesal process of anterior coxal fold (*amp*) much shorter than *alp*.

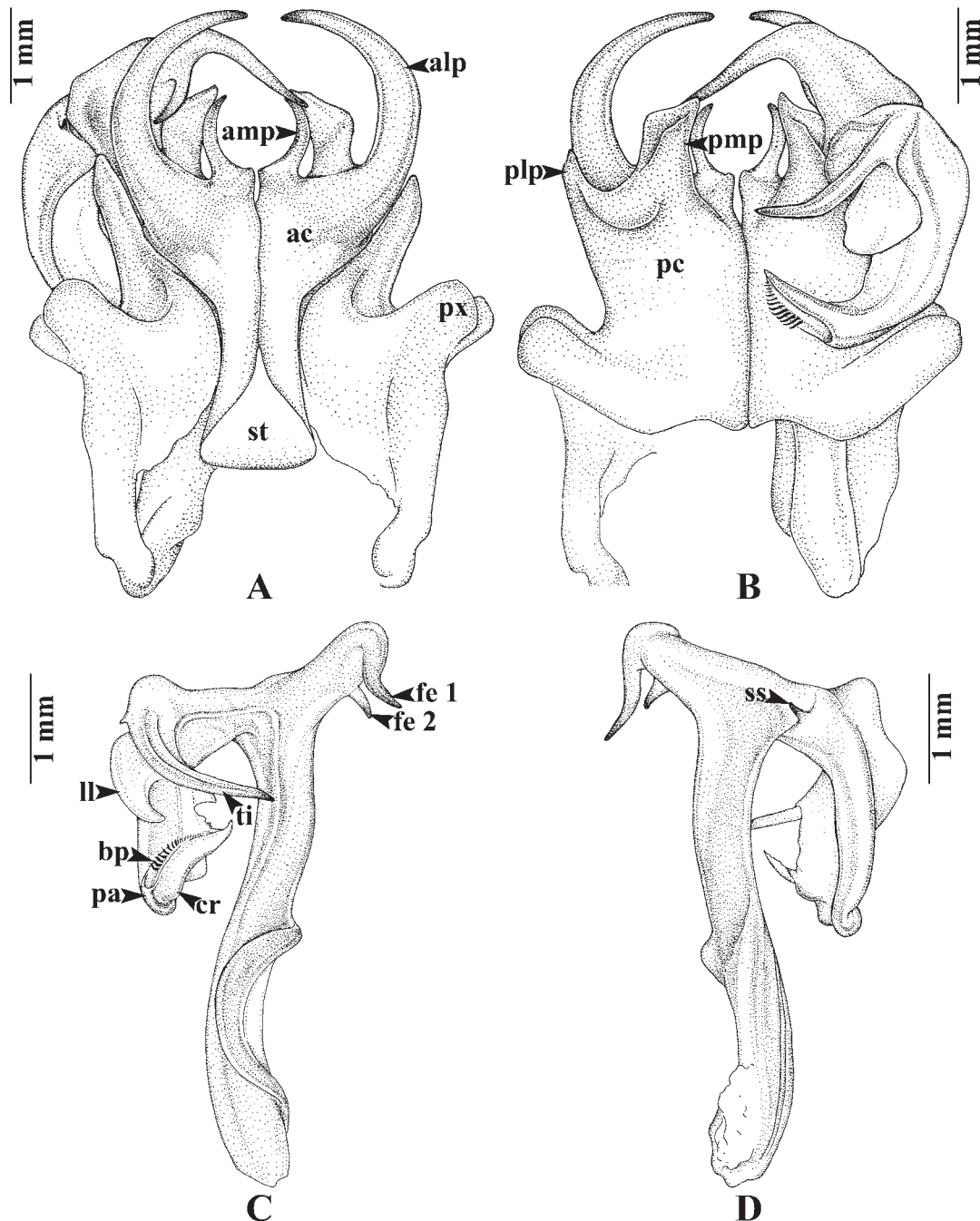
**Description:** Adult males with 61–63 podous rings, no apodous rings. Length ca. 13–14 cm (broken), width ca. 8.0–9.4 mm. Adult female with 63 podous rings, no apodous rings. Length ca. 10 cm, width ca. 7.5 mm. Overall color of living animal (Fig. 7B) brown. Legs brownish, metazona dark brown.

Gonopods (Figs. 2A–D): Anterior coxal fold (*ac*) (Fig. 2A): lateral process (*alp*) long, slender, regularly curved, sickle-shaped; mesal process (*amp*) much shorter than lateral process, curved, pointed. Posterior coxal fold (*pc*) (Fig. 2B) basally with moderately high lateral paracoxites (*px*); mesal process (*pmp*) distally rounded, visible in anterior view between *alp* and *amp* (In Demange's fig. 11 *pmp* looks like an additional process between *alp* and *amp*); lateral process (*plp*) erect, digitiform; shelf (*sh*) for accommodation of telopodite between *pmp* and *plp*. Telopodite (Figs. 2C–D) leaving coxite over shelf of posterior coxal fold;



double femoral spine (*fe*), the first *fe* (*fe 1*) longer than *fe 2*, slender, straight, terminally slightly curved, its tip *in situ* resting close to tip of *amp*, the second *fe* (*fe 2*) situated under *fe 1*, very short, slender, curved rearwards; tibial spine (*ti*) long, slender, curving in horizontal plane, its tip *in situ* resting close to base of *pmp*; apical part: lamellar lobe (*ll*) flattened, bent down; a small slender spine (*ss*) at base of apical part, opposite the origin of tibial spine; palette (*pa*) simple, flattened, with a longitudinal rounded crest (*cr*) near tip; distally with about ten brownish blepharochaetae (*bp*).

**Distribution** (Fig. 8): Known from several localities in THAILAND, Phang Nga Province, and also from Phuket Island (THAILAND, Phuket Province).

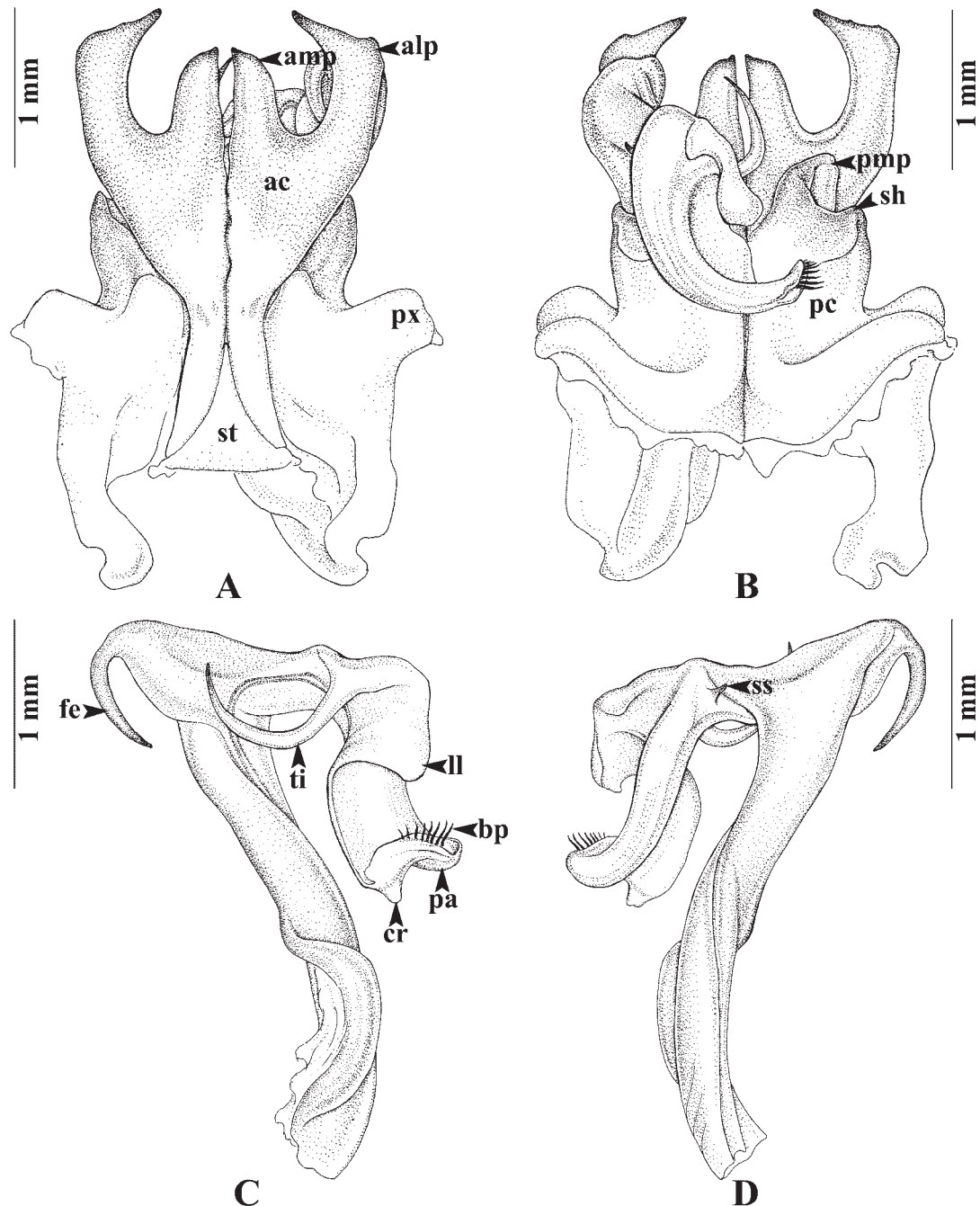


**FIGURE 2.** *Thyropygus enghoffi*, holotype, gonopods. A: anterior view, right telopodite removed. B: posterior view, right telopodite removed. C: right telopodite, posterior-mesal view. D: right telopodite, anterior-lateral view.

***Thyropygus casjeekeli* n. sp.**  
(Figs. 3A–D, 7C)

**Material:** HOLOTYPE male THAILAND, Krabi Province, Klong Thom district, Sra Morakot, 7° 55' 22" N, 99° 15' 35" E. 15 January 2009. S. Panha, T. Krutchuen, C. Sutcharit and P. Pimvichai leg., (CUMZ). – Paratype: 1 female, same data as holotype (CUMZ).

**Etymology:** The species is named in honour of Casimir Albrecht Willem (“Cas”) Jeekel, in recognition of his lifelong devotion to diplopodology, especially his recent catalogue of Oriental Harpagophoridae.



**FIGURE 3.** *Thyropygus casjeekeli*, holotype, gonopods. A: anterior view, left telopodite removed. B: posterior view, left telopodite removed. C: left telopodite, posterior-mesal view. D: left telopodite, anterior-lateral view.

**Diagnosis:** A species of the *bifurcus* subgroup. Lateral margin of lateral process of anterior coxal fold (*alp*) without a small crest or spine. Similar in this respect to *T. enghoffi* and *T. richardhoffmani*. Differs from

these species by having only a single femoral spine. Particularly similar to *T. richardhoffmani*, differing from it by the presence of a small spine (*ss*) at base of apical part, opposite the origin of the tibial spine.

**Description:** Adult male with 60 podous rings, no apodous rings. Length ca. 10 cm, width ca. 6.6 mm. Adult female with 59 podous rings, no apodous rings. Length ca. 9 cm, width ca. 6.6 mm. Overall color of living animal (Fig. 7C) brown; prozona yellowish brown, metazona darker brown.

Gonopods (Figs. 3A–D): Anterior coxal fold (*ac*) (Fig. 3A): lateral process (*alp*) flattened, slightly curved, inflexed; mesal process (*amp*) shorter than *alp*, flattened, as broad as *alp*, directed distad. Posterior coxal fold (*pc*) (Fig. 3B) basally with moderately high lateral paracoxites (*px*), distally truncate, forming shelf (*sh*) for accommodation of telopodite, mesal process (*pmp*) curved distolaterad. Telopodite (Figs. 3C–D) leaving coxite over shelf of posterior coxal fold; femoral spine (*fe*) very long, very slender, curved backward, *in situ* resting against posterior surface of base of *alp*; tibial spine (*ti*) long, slender, curving in horizontal plane, its tip *in situ* resting close to tip of *amp*; apical part: lamellar lobe (*ll*) broad, bent down; palette (*pa*) simple, gutter-like, with a longitudinal rounded crest (*cr*) near tip; distally with about seven brownish blepharochaetae (*bp*).

**Distribution** (Fig. 8): Known only from the type locality.

### ***Thyropygus demangei* n. sp.**

(Figs. 4A–E, 7A)

**Material:** HOLOTYPE male THAILAND, Trang Province, Hat Chao Mai National Park, 7° 25' 20" N, 99° 20' 55" E. 26 October 1991. M. Andersen, O. Martin and N. Scharff leg., (ZMUC). – Paratypes: 7 males, 2 females, same data as holotype (ZMUC), 1 male, 3 females, 1 juvenile, same locality as holotype. 14 January 2009. C. Sutcharit, P. Tongkerd, P. Pimvichai and members of Animal Systematics Research Unit leg., (CUMZ).

**Etymology:** The species is named in honour of Jean-Marie Demange in recognition of his lifelong devotion to diplopodology, especially his vast and indispensable contribution to the taxonomy of Harpagophoridae

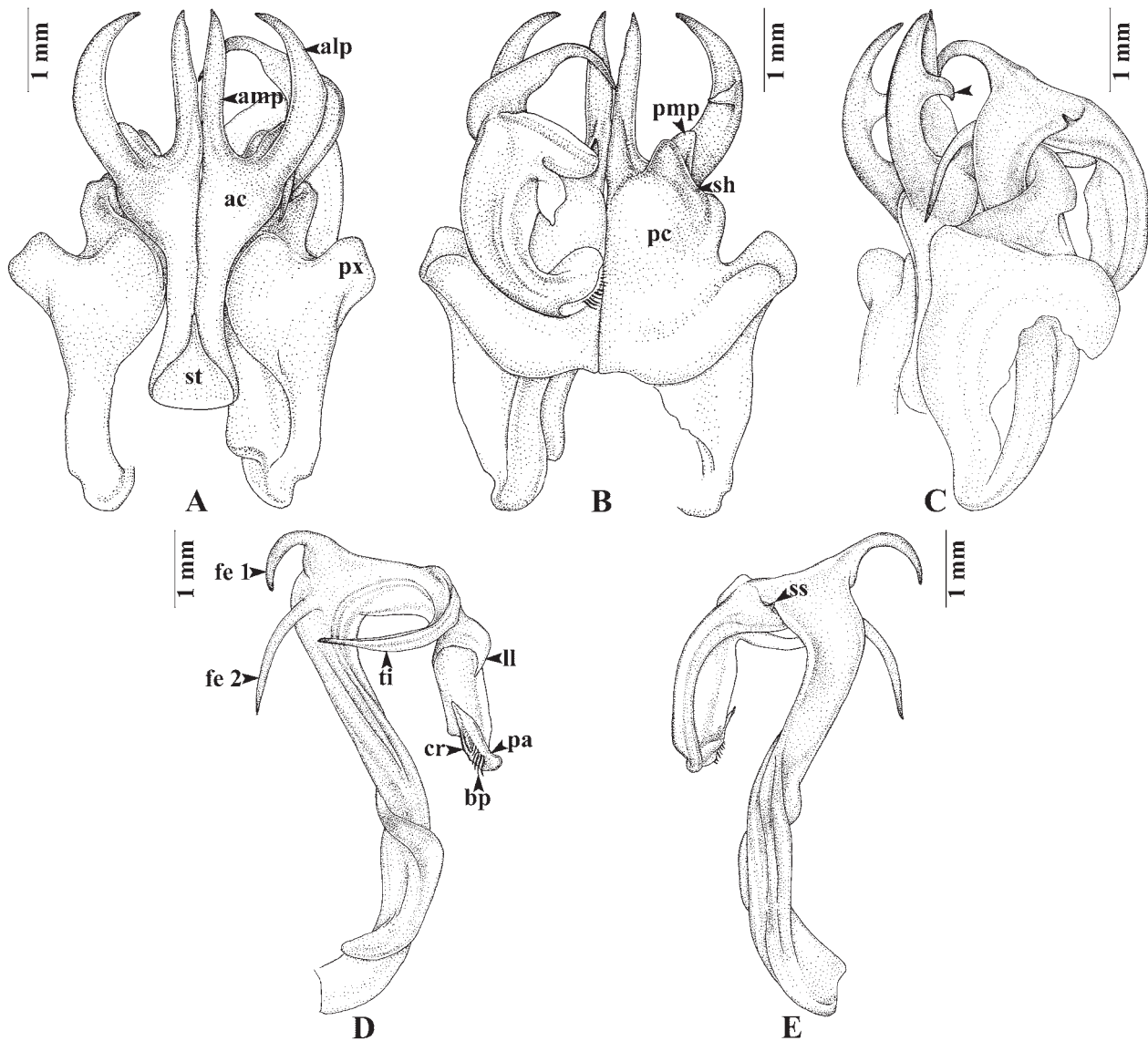
**Diagnosis:** A species of the *bifurcus* subgroup. Lateral margin of lateral process of anterior coxal fold (*alp*) with a caudad curved spine. Similar in this respect to *T. bifurcus* and *T. quadricuspis*. Differs from these species by having the mesal process of anterior coxal fold (*amp*) slightly longer than *alp*, *alp* with a long caudad spine, and by having a small spine (*ss*) at base of apical part, opposite the origin of the tibial spine.

**Description:** Adult males with 54–60 podous rings, no apodous rings. Length ca. 11–12 cm, width ca. 7.0–7.6 mm. Adult females with 55–60 podous rings, no apodous rings. Length ca. 9–12 cm, width ca. 7.1–7.9 mm. Overall color of living animal (Fig. 7A) brown with a longitudinal yellowish brown band mid-dorsally on the body; metazona dark brown.

Gonopods (Figs. 4A–E): Anterior coxal fold (*ac*) (Fig. 4A): lateral process (*alp*) long, slender, inflexed, lateral margin with short curved backward spine (Fig. 4C, arrow); mesal process (*amp*) slender, very long, slightly longer than *alp*, straight, directed distad, pointed. Posterior coxal fold (*pc*) basally with moderately high paracoxites (*px*), distally truncate, forming shelf (*sh*) for accommodation of telopodite; mesal process (*pmp*) very small, directed distolaterad. Telopodite (Figs. 4D–E) leaving coxite over shelf of posterior coxal fold; double femoral spine (*fe*), the first *fe* (*fe 1*) long, basally broad, gradually tapering towards end, *in situ* curving mesad and ending in sharp point, the second *fe* (*fe 2*) situated under *fe 1*, very slender, very long, as long as *ti*; tibial spine (*ti*) long, slender, curving in horizontal plane, its tip *in situ* resting close to the origin of *amp*; apical part: lamellar lobe (*ll*) small, bent down; a small slender spine (*ss*) at base of apical part, opposite the origin of tibial spine; palette (*pa*) simple, flattened, with a small longitudinal rounded crest (*cr*) near tip; distally with about eight brownish blepharochaetae (*bp*).

**Distribution** (Fig. 8): Known only from the type locality.





**FIGURE 4.** *Thyropygus demangei*, holotype, gonopods. A: anterior view, left telopodite removed. B: posterior view, left telopodite removed. C: lateral view. D: left telopodite, posterior-mesal view. E: left telopodite, anterior-lateral view.

***Thyropygus quadricuspis* n. sp.**  
(Figs. 5A–E, 7D)

**Material:** HOLOTYPE male THAILAND, Trang Province, Huai Yot district, Tam Khao Pina Temple, 7° 51' 1" N, 99° 31' 29" E. 14 January 2009. P. Pimvichai, C. Sutcharit and members of Animal Systematics Research Unit leg., (CUMZ). – Paratypes: 2 males and 4 females, same data as holotype (CUMZ), 2 males, 3 females, same data as holotype (ZMUC).

**Etymology:** The species epithet is a noun in apposition and means “four prongs” and refers to the superficial similarity of the anterior gonopod to a four-pronged fish spear.

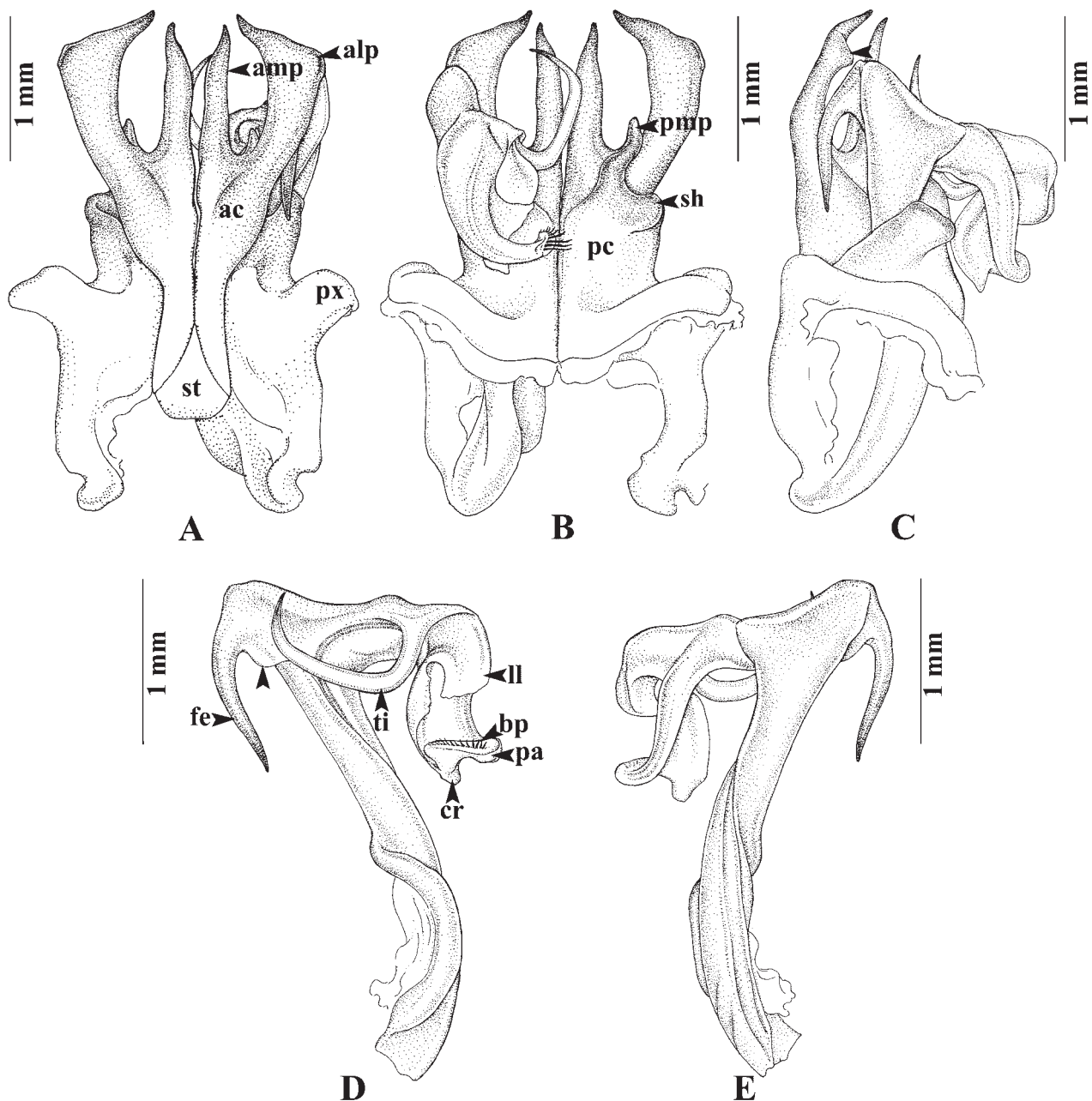
**Diagnosis:** A species of the *bifurcus* subgroup. Lateral margin of lateral process of anterior coxal fold (*alp*) with a small crest. Similar in this respect to *T. bifurcus* and *T. demangei*. Differs from these species by having a single femoral spine (*fe*).

**Description:** Adult males with 57–59 podous rings, no apodous rings. Length ca. 8–10 cm, width ca. 5.4–6.2 mm. Adult females with 57–61 podous rings, no apodous rings. Length ca. 8–10 cm, width ca.

6.2–6.8 mm. Overall color of living animal (Fig. 7D) brown, with a longitudinal yellowish brown band mid-dorsally on the body; epiproct and paraprocts darker brown.

Gonopods (Figs. 5A–E): Anterior coxal fold (*ac*) (Fig. 5A): lateral process (*alp*) flattened, slightly curved, inflexed, with a lateral short sharp crest near tip (Fig. 5C, arrow); mesal process (*amp*) almost as long as *alp*, straight, directed distad. Posterior coxal fold (*pc*) (Fig. 5B) basally with moderately high lateral paracoxites (*px*), distally truncate, forming shelf (*sh*) for accommodation of telopodite, mesal process (*pmp*) slender, directed anteriad. Telopodite (Figs. 5D–E) leaving coxite over shelf of posterior coxal fold; femoral spine (*fe*) very long, slender, curved downward, with a small lamella at base of *fe*, *in situ* resting close to the middle part of *alp*; tibial spine (*ti*) long, slender, curving in horizontal plane, its tip *in situ* resting close to tip of *amp*; apical part: lamellar lobe (*ll*) broad, bent down; palette (*pa*) simple, gutter-like, with a longitudinal rounded crest (*cr*) near tip; distally with about eight brownish blepharochaetae (*bp*).

**Distribution** (Fig. 8): Known only from the type locality.

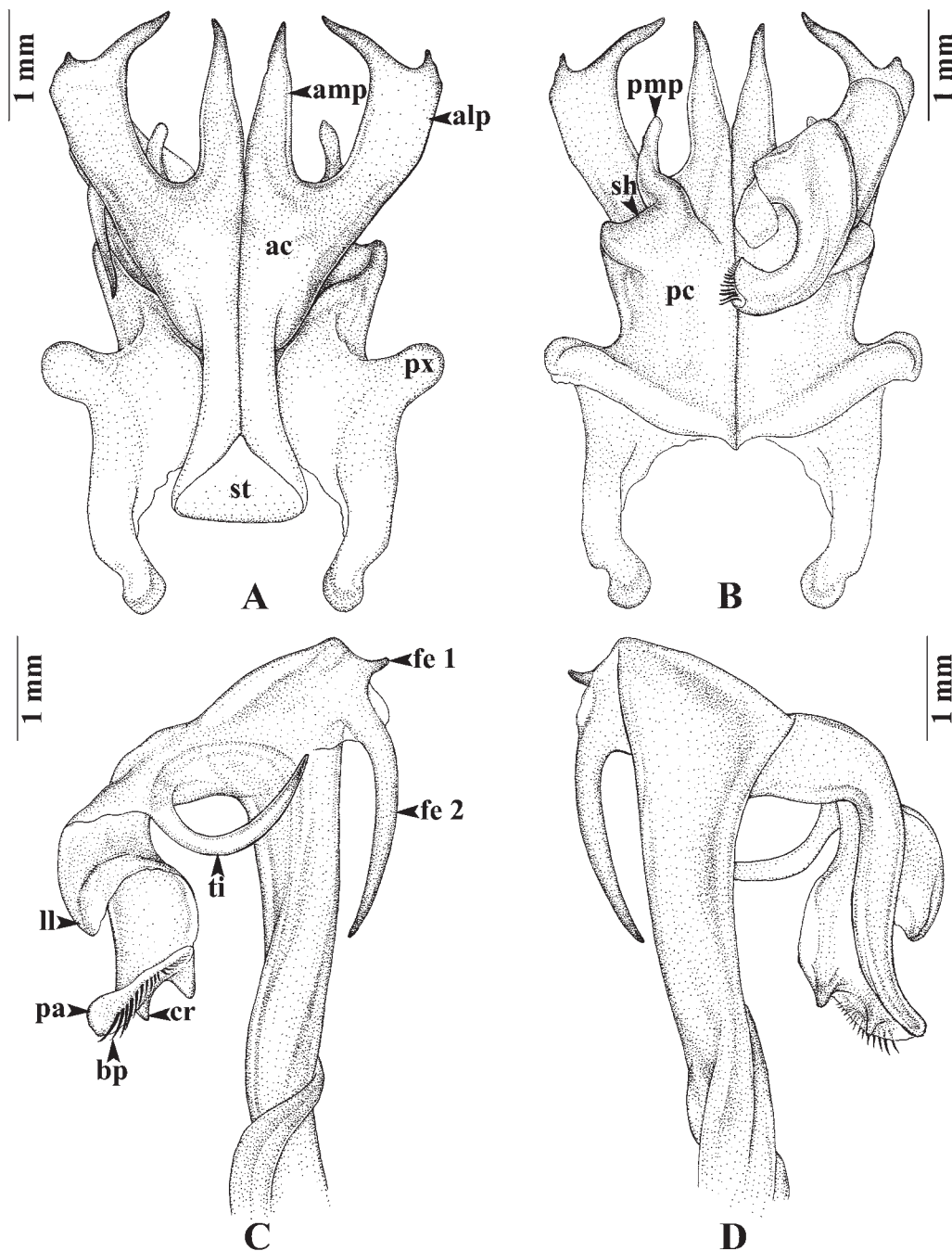


**FIGURE 5.** *Thyropygus quadricuspis*, holotype, gonopods. A: anterior view, left telopodite removed. B: posterior view, left telopodite removed. C: lateral view. D: left telopodite, posterior-mesal view. E: left telopodite, anterior-lateral view.

***Thyropygus richardhoffmani* n. sp.**  
(Figs. 6A–D, 7E)

**Material:** HOLOTYPE male THAILAND, Trang Province, Na Yong district, Khao Chong, Banthat Mountain, 7° 32' 45" N, 99° 46' 27" E. 24–26 January 1999. M. Andersen leg., (ZMUC). - Paratypes: 4 males 6 females, same locality as holotype. 14 January 2009. P. Pimvichai and members of Animal Systematics Research Unit leg., (CUMZ).

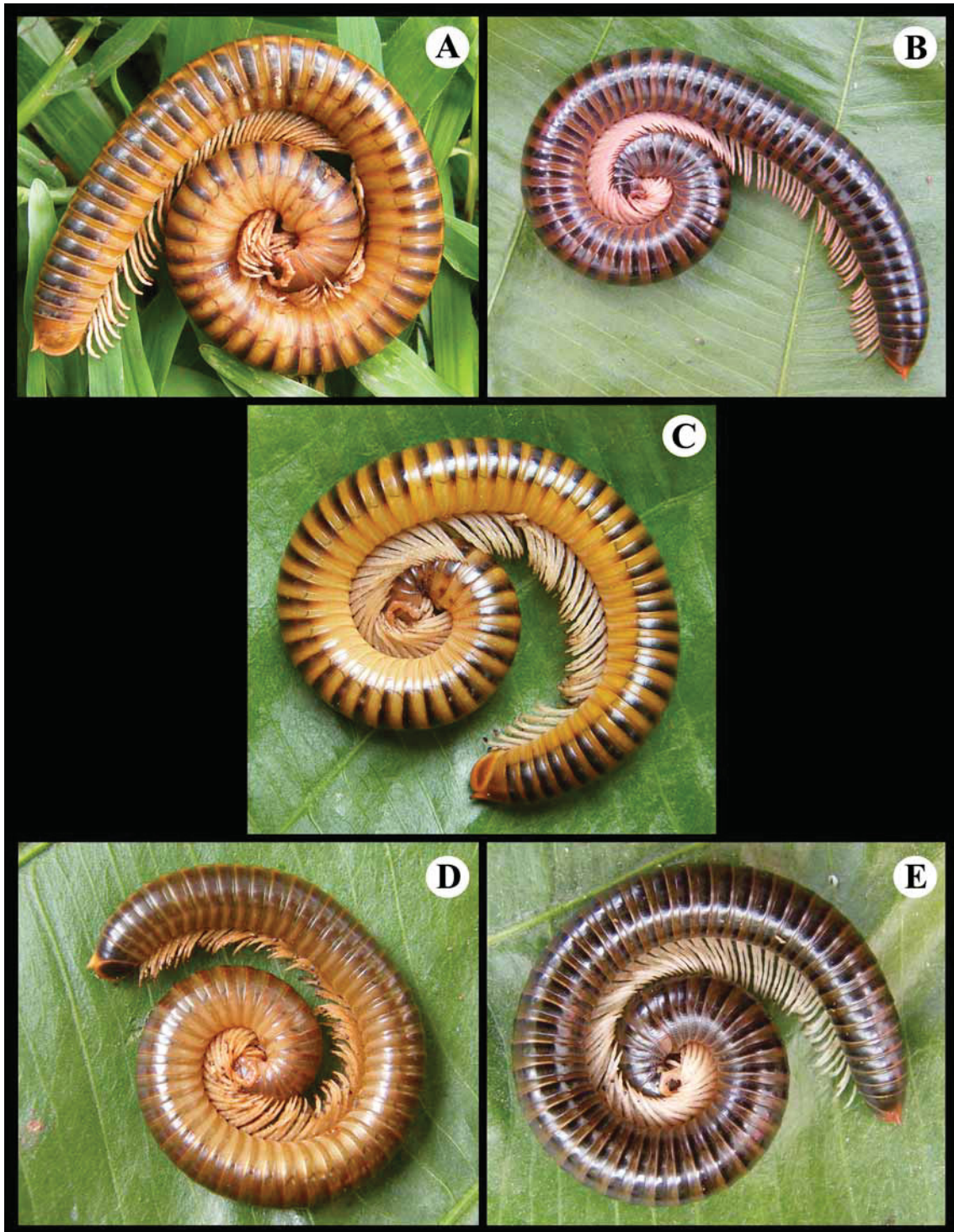
**Etymology:** The species is named in honour of Richard L. Hoffman in recognition of his lifelong devotion to diplopodology, especially his very useful account of the genus *Thyropygus*.



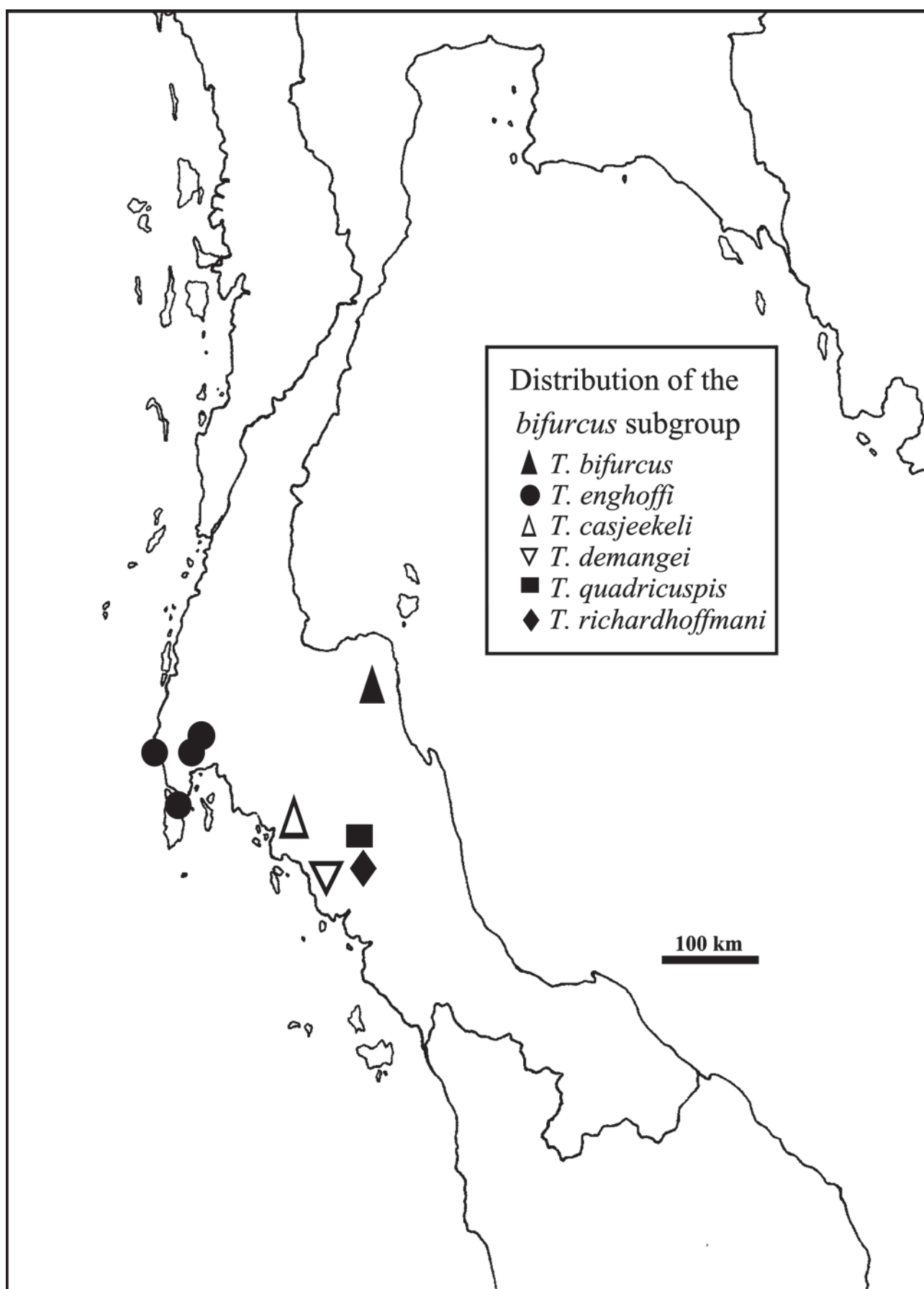
**FIGURE 6.** *Thyropygus richardhoffmani*, holotype, gonopods. A: anterior view, right telopodite removed. B: posterior view, right telopodite removed. C: right telopodite, posterior-mesal view. D: right telopodite, anterior-lateral view.



**Diagnosis:** A species of the *bifurcus* subgroup. Lateral margin of lateral process of anterior coxal fold (*alp*) with neither crest nor spine. Similar in this respect to *T. casjeekeli* and *T. enghoffi*. Differ from *T. enghoffi* by having a very short first femoral spine (*fe 1*), a very long the second femoral spine (*fe 2*) and a small lamella at both side of base of *fe 2*. Particularly similar to *T. casjeekeli*, differing from it by having a double femoral spine (*fe*) and by the absence of a small spine (*ss*) at base of apical part, opposite the origin of the tibial spine.



**FIGURE 7.** A: *Thyropygus demangei*, living male. B: *Thyropygus enghoffi*, living male. C: *Thyropygus casjeekeli*, living male. D: *Thyropygus quadricuspis*, living male. E: *Thyropygus richardhoffmani*, living male.



**FIGURE 8.** Map of peninsular Thailand, showing the known distribution of the species of the *T. bifurcus* subgroup.



**Description:** Adult males with 59–64 podous rings, no apodous rings. Length ca. 8–12 cm, width ca. 6.0–7.1 mm. Adult females with 58–62 podous rings, no apodous rings. Length ca. 9–12 cm, width ca. 6.3–7.7 mm. Overall color of living animal (Fig. 7E) dark brown; legs brownish.

Gonopods (Figs. 6A–D): Anterior coxal fold (*ac*) (Fig. 6A): lateral process (*alp*) flattened, slightly curved, terminating in two cusps, the outer one very short, the inner one very long; mesal process (*amp*) very long, almost as long as *alp*, straight, directed distad, pointed. Posterior coxal fold (*pc*) (Fig. 6B) basally with moderately high paracoxites (*px*), distally truncate, forming shelf (*sh*) for accommodation of telopodite, mesal process (*pmp*) slender, directed anteriad. Telopodite (Figs. 6C–D) leaving coxite over shelf of posterior coxal fold; double femoral spine (*fe*), the first *fe* (*fe 1*), very short, pointed, situated above *fe 2*, the second *fe* (*fe 2*) very long, as long as *ti*, slender, curved downward, with a small lamella at both side of base; tibial spine (*ti*) long, slender, curving in horizontal plane, its tip *in situ* resting close to base of *amp*; apical part: lamellar lobe (*ll*) broad, bent down; palette (*pa*) simple, gutter-like, with a longitudinal rounded crest (*cr*) near tip; distally with about nine brownish blepharochaetae (*bp*).

**Distribution** (Fig. 8): Known only from the type locality.

## Discussion

Following the division of the *Thyropygus allevatus* group into subgroups, initiated by Pimvichai *et al.*, 2009, we describe here six species in the *T. allevatus* group and assemble them in the *T. bifurcus* subgroup. Pimvichai *et al.* (2009) briefly characterized this subgroup, but newly acquired material necessitates a renewed diagnosis which is given above.

Like the *opinatus* subgroup, subject of our previous paper (Pimvichai *et al.*, 2009), the *bifurcus* subgroup consists of quite similar, allopatric species, differing in combinations of subtle, but in our opinion significant, gonopodal characters.

The main gonopodal variations in the *bifurcus* group are:

- the femoral spine (*fe*) is doubled in *T. bifurcus*, *T. demangei*, *T. enghoffi* and *T. richardhoffmani* but single in *T. casjeekeli* and *T. quadricuspis*.
- a small spine (*ss*) at the base of the apical part, opposite the origin of the tibial spine, is present in *T. enghoffi*, *T. casjeekeli* and *T. demangei*, but absent in *T. bifurcus*, *T. quadricuspis* and *T. richardhoffmani*.
- a small crest or spine on the lateral margin of the lateral process of anterior coxal fold (*alp*) is present in *T. bifurcus*, *T. demangei* and *T. quadricuspis*, but absent in *T. enghoffi*, *T. casjeekeli* and *T. richardhoffmani*.
- the mesal process of anterior coxal fold (*amp*) is shorter than the lateral process of the anterior coxal fold (*alp*) in *T. bifurcus*, *T. enghoffi* and *T. casjeekeli*, but almost as long as *alp* or slightly longer than *alp* in *T. demangei*, *T. quadricuspis* and *T. richardhoffmani*.
- the first femoral spine (*fe 1*) is very short in *T. richardhoffmani*, but relatively long in *T. bifurcus*, *T. enghoffi*, and *T. demangei*.
- the second femoral spine (*fe 2*) is very long, as long as the tibial spine (*ti*) in *T. demangei* and *T. richardhoffmani*, but very short in *T. bifurcus* and *T. enghoffi*.
- an additional lamella at both sides of the base of *fe 2* is present only in *T. richardhoffmani*, but absent in *T. bifurcus*, *T. enghoffi*, and *T. demangei*.

Ongoing analyses of phylogenetic relationships within *Thyropygus* will hopefully shed more light on the significance of these differences, as well as on the monophyly of the genus, its species groups, and their subgroups.

According to the material we have studied and the available literature, the *T. bifurcus* subgroup is distributed only in the southern part of Thailand, south of the Isthmus of Kra (Fig. 8).

## Corrections to Pimvichai *et al.* (2009)

In each of the gonopod plates in Pimvichai *et al.* (2009: figs. 6–17) there are drawings of an isolated telopodite said to be in “anterior view” and “posterior view”. In reality, the drawings labelled as “anterior view” show the telopodite in posterior-mesal view, and the drawings labelled “posterior view” show it in anterior-lateral view.

In the Table of contents, the page numbers are wrong by 16 pages.

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## References

- Demange, J.M. (1961) Matériaux pour servir à une revision des Harpagophoridae. *Mémoires du Muséum National d'Histoire Naturelle*, Sér. A (Zool.), 24, 1–274.
- Demange, J.M. (1986) Harpagophoridae de Thaïlande et de Malaisie (Myriapoda, Spirostreptida). *Bulletin du Muséum National d'Histoire Naturelle, Paris*, 4e sér., 8 sect. A, 851–865.
- Demange, J.M. (1989) Sur quelques Harpagophoridae du Sud-Est asiatique et de l'Inde (Myriapoda, Diplopoda, Spirostreptoidea). *Bulletin du Muséum National d'Histoire Naturelle, Paris*, 4e sér., 11 sect. A, 773–781.
- Enghoff, H. (2005) The millipedes of Thailand (Diplopoda). *Steenstrupia*, 29(1), 87–103.
- Hoffman, R.L. (1975) Studies on spirostreptoid millipeds. XI. A review of some Indonesian genera of the family Harpagophoridae. *Journal of Natural History*, 9, 121–152.
- Jeekel, C.A.W. (2006) A bibliographic catalogue of the Oriental Harpagophoridae (Diplopoda, Spirostreptida). *Myriapod Memoranda*, 9, 5–58.
- Pimvichai, P., Enghoff, H. & Panha, S. (2009) A revision of the *Thyropygus allevatus* group. Part 1: the *T. opinatus* subgroup (Diplopoda: Spirostreptida: Harpagophoridae). *Zootaxa*, 2016, 17–50.